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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/966,812	09/28/2001	Charles M. Lieber	HUV-039.01	3072

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EXAMINER
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LISH, PETER J

ART UNIT	PAPER NUMBER
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1754

DATE MAILED: 07/24/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/966,812

Applicant(s)

LIEBER ET AL.

Examiner

Peter J Lish

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 12 May 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-7, 10, 13, 17, 19, 21-24 and 26-29 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 26-29 is/are allowed.
- 6) ☒ Claim(s) 1-7, 10, 13, 17, 19, 21-24, and 26-29 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_.
- 4) ☐ Interview Summary (PTO-413) Paper No(s) \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

### DETAILED ACTION

Applicant's arguments filed 05/12/03 have been fully considered but they are not persuasive. Regarding the arguments that Dai does not teach disconnecting the nanotube tip to deposit a nanotube segment on the substrate, it is first noted that this limitation applies only to claims 23-24, not to claims 21-24 as declared by applicant. Furthermore, the nanotube is shortened by breakage of the nanotube tip, which inherently lands on the substrate and is thus "deposited on the substrate".

Regarding arguments toward the use of colloidal catalyst material for the growth of single-walled carbon nanotubes, the arguments have been considered but are moot in view of the new ground(s) of rejection.

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

### *Claim Rejections - 35 USC § 102*

Claims 1-3, 6-7, 10, 13, 19, and 21 are rejected under 35 U.S.C. 102(e) as being anticipated by Dai et al. (USPN 6,401,526).

Dai et al. disclose a process for producing nanotube tips by applying a metallic catalyst to a tip assembly and growing a carbon nanotube(s) over the catalyst. The tip assembly includes an array of silicon pyramidal tips, or multifaceted probes, integrated onto commercially available AFM cantilevers (column 4, lines 58-61 and Figure 2). The catalyst is applied to the tips by contacting the tip with a liquid catalyst precursor. The liquid precursor comprises a metal-containing salt, such as iron chloride, nitrate, or sulfate, a long-chain molecular compound, and a

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solvent, such as an alcohol. Dai et al. does not explicitly disclose the use of metallic catalytic colloidal materials for the growth of single-walled nanotubes. However, it is expected that the liquid catalytic solutions prepared by the mixing of a metal-containing salt, a long-chain molecular compounds, and a solvent produce a colloidal suspension because they contain the materials necessary to produce micelles and thus catalytic colloidal material. The nanotubes grown using the process of Dai et al. include individual SWNTs and bundles of SWNTs (column 6, lines 1-5).

Dai et al. also disclose a process for shortening the as-grown carbon nanotube tips by electric etching (column 7).

***Claim Rejections - 35 USC § 103***

Claims 17 and 22-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dai et al. (US 6,401,526).

Regarding claim 17, while Dai et al. does not specifically disclose the use of ethylene as the carbon-containing gas, it would have been obvious to one of ordinary skill to use ethylene in place of the hydrocarbons as taught, such as methane, ethane, butane, propane, etc., because ethylene is a carbon-containing gas which is capable of producing single-walled nanotubes by chemical vapor deposition processes.

Regarding claims 22-24, Dai et al. teach an electric etching nanotube shortening process. The SWNT is brought into contact with a heavily doped silicon substrate. A voltage is applied between the tube and substrate and gradually increased until the loss of tube-substrate contact occurs as a result of nanotube shortening. This allows the lengths of SWNTs to be reduced in

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steps of about 30 nm (column 7, lines 43-52). It is also taught that the SWNTs are typically shortened from a length of 1-20 microns down to 30-100 nm. It therefore would have been obvious to one of ordinary skill at the time of invention to perform multiple shortening steps by using a pulsed technique in order to reach nanotubes of a desired length.

Claims 4 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dai et al. as applied to claim 1-3 above, and further in view of Kong et al. ("Synthesis of individual single-walled...").

Dai et al. do not teach the application of a mask to the tip assembly. However, Dai et al. does teach numerous methods for controlling the application of the catalyst precursor liquid such as a stamping method and special tower-tip forms (column 6). Kong et al. teach a method of controlling the application of a catalyst precursor liquid by the use of removable masks of polymer, specifically PMMA (Figure 1). It would have been obvious to one of ordinary skill at the time of invention to use the masks of Kong et al. on the process of Dai et al. in order to control the application of the catalyst precursor liquid.

Claims 1-3, 6-7, 10, 13, 19, and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dai et al. and further in view of Su et al. ("Lattice-Oriented Growth of Single-Walled Carbon Nanotubes").

Dai et al. is applied above. Dai et al. does not explicitly teach the use of catalytic colloidal materials. Su et al. teach a method of producing catalyst nanoparticles, suitable for the growth of single-walled carbon nanotubes, in a liquid colloidal phase. It would have been

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obvious to one of ordinary skill at the time of invention to use the liquid phase metallic colloidal materials of Su et al. in the process of Dai et al. in order to provide finely dispersed catalytic nanoparticles capable of growing single-walled carbon nanotubes.

*Allowable Subject Matter*

Claims 26-29 are allowed.

*Conclusion*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Peter J Lish whose telephone number is 703-308-1772. The examiner can normally be reached on 9:00-6:00 Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stanley Silverman can be reached on 703-308-3837. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-305-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone-number is 703-308-0661.



PL  
July 21, 2003

STUART L. HENDRICKSON  
PRIMARY EXAMINER

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